SCH4R1 DEVELOPMENT OF ATOMIC THEORY - PART 1 WS-3

1. Who is credited, early on in history, with coming up with the notion that there is such a thing called an atom? Did this lad have any experimental evidence to support such an idea?

   Democritus, a Greek philosopher, is the earliest known person to have conceived of the idea of an atom. He had not experimental evidence to support his idea.

2. What did the term 'atom' mean?

   The term 'atom' is derived from the Greek word 'atomos' meaning indivisible.

3. The notion of the atom was abandoned due to an influential philosopher by what name? How many years went by before the idea of an atom resurfaced?

   Aristotle was another Greek philosopher who was very influential in his day. The idea of an atom did not come back into play until nearly two thousand years later.

4. Who is credited with the regeneration of the atomic model? What was he attempting to do with his model?

   Many different scientists were working on different aspects of matter. Dalton is credited with coming up with a theory that attempted to explain what was known at the time, in particular, the Law of Conservation of Mass, The Law of Definite Proportions and the Law of Multiple Proportions.

5. Who is credited with the discovery of a particle smaller than the atom (a sub-atomic particle)? Describe his new model which still incorporated many of Dalton's ideas yet represented an enhancement to the model. Indicate how he incorporated the notion of positive and negative charges.

   Many people were working on seeing if there were particles smaller than the atom. Thomson discovered that there was a 'negatively' charged particle which he called the electron; Goldstein soon after had discovered the 'positively' charged particle. Dalton's ideas had not changed with the discovery of these particles. Only the model had changed. The atom was now seen as a sphere with negative charges embedded in a mass of positive charge.

6. Models are designed to be tested. Successful models withstand the test of time so to speak. Describe the experiment created by Lord Rutherford to test Thomson's model. In doing so, indicate what the expected to observe, what he wound up observing, and how these observations resulted in a revision to the model.

   Describe Rutherford's experimental set-up (the Gold Foil Expt.). Rutherford expected to see that the alpha particles would blast through the gold foil. He indeed observed this but he was surprised to see that occasionally there would be an alpha particle that would bounce back of the gold foil. To him, whatever the alpha particle was hitting had to be very tiny and very dense to withstand the collision. Again the model is revised, this time showing a nucleus which contained the positive charge and electrons orbiting about, like the planets orbit the Sun.

7. What convinced scientists that there had to be another particle(s) in addition to the proton and the electron? Who discovered the neutron?

   The mass of the proton is approximately 2000x more massive than the electron. Scientists had devised a way to determine the number of protons and electrons present in an atom of an element. When they added up the mass of these protons/electrons, it did not add up to the known mass of the element. Something was missing. Chadwick later discovered the neutron, a particle that has no electric charge yet is of approximately the same mass as the proton.

8. Where, in light of Rutherford's data, would the neutron have to be placed in the new model? Why?

   If the neutron, which is just as massive as the proton, were to have been placed orbiting the nucleus, then there would be less empty space and, according to Rutherford's experiment, should result in more collisions. In order to keep with the observations gathered in Rutherford's experiment, the neutron was placed in the densely packed nucleus.

9. Although Rutherford's model represented an improvement over its predecessors, what problem existed with it, that is, what could it not explain?

   Rutherford's model represented an improvement over its predecessors in that it was supported by empirical evidence. However, there were a few questions that it could not explain:

   1. *How are the protons and neutrons arranged in the nucleus? If the protons are positively charged and they are all placed in a small area, why do they not repel each other?*

   2. *He says that the electrons orbit the nucleus. Where, in relation to the nucleus, do these orbits occur? How does the arrangement of electrons differ from atom to atom?*

   3. *The proton is positively charged and the electron is negatively charged – opposites attract. Why then, doesn't the electron come into the nucleus? How does it remain orbiting about the nucleus?*

   4. *How do atoms come together to form compounds in their various ratios and various structures?*

   THESE ARE QUESTIONS THAT GUIDED RESEARCH FOR THE NEXT SEVERAL YEARS. REMEMBER THAT IT TOOK OVER 2000 YEARS TO GET TO THIS STAGE. THE CURRENT UNDERSTANDING OF THE ATOMIC MODEL DEVELOPED OVER A SPAN OF 20-30 YEARS, ESSENTIALLY IN THE BLINK OF AN EYE!